

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
18 December 2003 (18.12.2003)

PCT

(10) International Publication Number
WO 2003/104601 A3

(51) International Patent Classification⁷: **E21B 19/16**

(21) International Application Number:
PCT/US2003/013787

(22) International Filing Date: 5 May 2003 (05.05.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/387,486 10 June 2002 (10.06.2002) US

CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,
SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN,
YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant (for all designated States except US): ENVEN-
TURE GLOBAL TECHNOLOGY [US/US]; 16200 A
Park Row, Houston, TX 77084 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): BRISCO, David, Paul
[US/US]; 405 Westridge Drive, Duncan, OK 73533 (US).

(74) Agent: MATTINGLY, Todd; Haynes and Boone, LLP,
Suite 4300, 1000 Louisiana Street, Houston, TX 77002-
5012 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,

Declaration under Rule 4.17:

— of inventorship (Rule 4.17(iv)) for US only

Published:

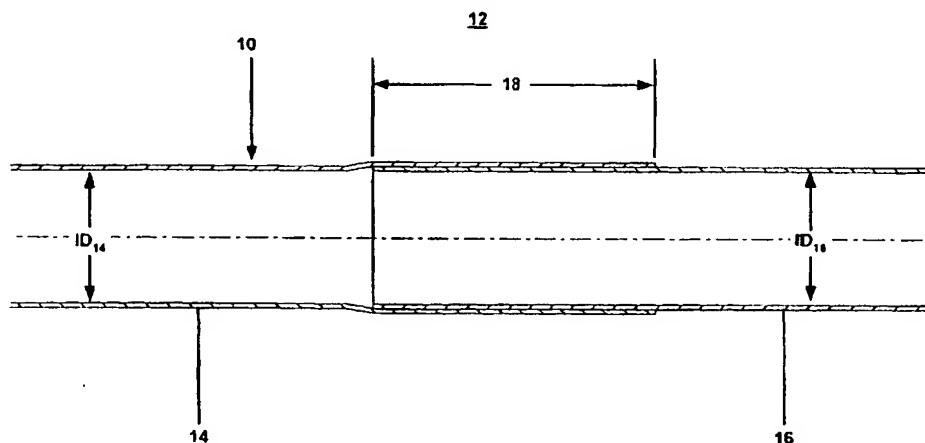
— with international search report

— before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

(88) Date of publication of the international search report:
15 July 2004

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: MONO-DIAMETER WELLBORE CASING



(57) Abstract: A mono diameter wellbore casing (14, 16).

BEST AVAILABLE COPY

WO 2003/104601 A3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/13787

A. CLASSIFICATION OF SUBJECT MATTER		
IPC(7) : E21B 19/16		
US CL : 166/380,207		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) U.S. : 166/120-122,187,206,207,380,382,387		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) East: (diameter\$1 with (casing pipe conduit tub\$5))		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,142,230 A (SMALLEY et al.) 07 November 2000 (07.11.2000), see entire document, especially Figs 6-11.	1-10, 19-36
X	US 6,263,968 B1 (FREEMAN et al.) 24 July 2001 (24.07.2001), see entire document, especially Figs. 4-9.	1, 6
A, P	US 6,497,289 B1 (COOK et al.) 24 December 2002 (24.12.2002), see entire document.	1-36
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 26 June 2003 (26.06.2003)		Date of mailing of the international search report 28 MAY 2004
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703)305-3230		Authorized officer Zakiya N. Walker <i>Zakiya N. Walker for</i> Telephone No. (703) 308-2168

**(19) World Intellectual Property
Organization
International Bureau**



(43) International Publication Date
18 December 2003 (18.12.2003)

PCT

(10) International Publication Number
WO 2003/104601 A3

(51) International Patent Classification⁷: E21B 19/16

LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PI, PL, PT, RO, RU, SD, SE, SG,
SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN,
YU, ZA, ZM, ZW.

(21) International Application Number: PCT/US2003/013787

(22) International Filing Date: 5 May 2003 (05.05.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data: 60/387,486 10 June 2002 (10.06.2002) US

(84) **Designated States (regional):** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SI, SZ, TZ, UG, ZM, ZW). Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM). European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR). OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GO, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

- of inventorship (Rule 4.17(iv)) for US only

Published:

— with international search report
— with amended claims

(71) Applicant (for all designated States except US): **ENVENTURE GLOBAL TECHNOLOGY** [US/US]; 16200 A Park Row, Houston, TX 77084 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **BRISCO, David, Paul**
[US/US]; 405 Westridge Drive, Duncan, OK 73533 (US).

(88) Date of publication of the international search report:
15 July 2004

(74) Agent: MATTINGLY, Todd; Haynes and Boone, LLP, Suite 3100, 901 Main Street, Dallas, TX 75202 (US).

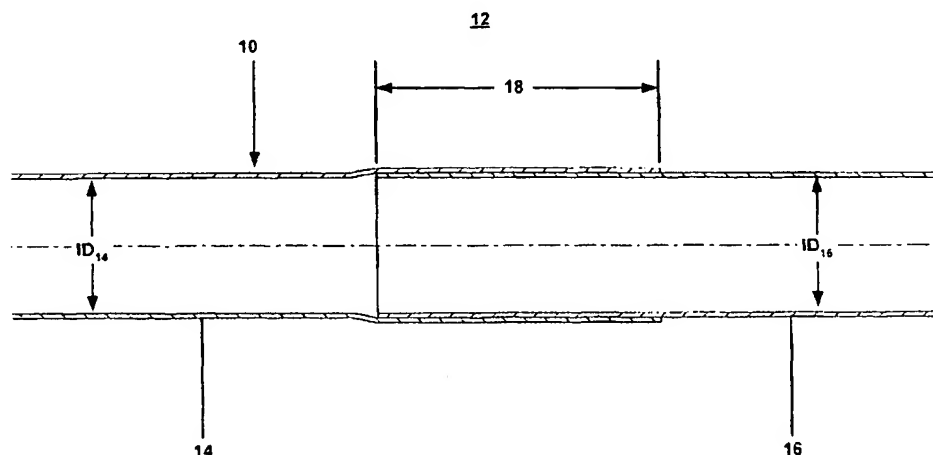
Date of publication of the amended claims:

10 September 2004

(81) **Designated States (national):** AF, AG, AI, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MONO-DIAMETER WELLBORE CASING



(57) **Abstract:** A mono diameter wellbore casing (14, 16).

WO 2003/104601 A3

[received by the International Bureau on 27 July 2004 (27.07.04);
original claims 1-36 replaced by amended claims 1-46 (9 pages)]

What is claimed is:

1. A method of forming a mono diameter wellbore casing within a borehole that traverses a subterranean formation, comprising:
positioning a first wellbore casing within the borehole;
radially expanding and plastically deforming the first wellbore casing within the borehole;
positioning a second wellbore casing within the borehole in overlapping relation to the first wellbore casing;
radially expanding and plastically deforming the second wellbore casing within the borehole;
radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings; and
radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing;
wherein the inside diameter of the portion of the first wellbore casing that does not overlap with the second wellbore casing is equal to the inside diameter of the radially expanded and plastically deformed portions of the second wellbore casing.
2. The method of claim 1, wherein radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings comprises:
positioning a telescoping radial expansion device comprising an outer sleeve and an inner sleeve positioned within and movably coupled to the outer sleeve comprising a tubular expansion cone proximate the end of the second wellbore casing; and
injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage the first wellbore casing and cause the inner sleeve to extend out of the outer sleeve into the overlapping portions of the first and second wellbore casings to cause the tubular expansion cone to radially expand and plastically deform the overlapping portions of the first and second wellbore casings.
3. The method of claim 2, further comprising:
conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.
4. The method of claim 2, wherein radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing comprises:
reducing the operating pressure within the telescoping radial expansion device;
moving the outer sleeve onto the inner sleeve of the telescoping radial expansion device; and
injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage at least one of the first and second wellbore casings and cause the inner sleeve to extend out of the outer sleeve into the second wellbore casing to cause

the tubular expansion cone to radially expand and plastically deform at least a portion of the second wellbore casing.

5. The method of claim 4, further comprising:
conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.
6. An apparatus for forming a mono diameter wellbore casing, comprising:
means for positioning a first wellbore casing within the borehole;
means for radially expanding and plastically deforming the first wellbore casing within the borehole;
means for positioning a second wellbore casing within the borehole in overlapping relation to the first wellbore casing;
means for radially expanding and plastically deforming the second wellbore casing within the borehole;
means for radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings; and
means for radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing;
wherein the inside diameter of the portion of the first wellbore casing that does not overlap with the second wellbore casing is equal to the inside diameter of the radially expanded and plastically deformed portions of the second wellbore casing.
7. The apparatus of claim 6, wherein means for radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings comprises:
means for positioning a telescoping radial expansion device comprising an outer sleeve and an inner sleeve positioned within and movably coupled to the outer sleeve comprising a tubular expansion cone proximate the end of the second wellbore casing; and
means for injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage the first wellbore casing and cause the inner sleeve to extend out of the outer sleeve into the overlapping portions of the first and second wellbore casings to cause the tubular expansion cone to radially expand and plastically deform the overlapping portions of the first and second wellbore casings.
8. The method of claim 7, further comprising:
conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.
9. The apparatus of claim 7, wherein means for radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing comprises:
means for reducing the operating pressure within the telescoping radial expansion device;
means for moving the outer sleeve onto the inner sleeve of the telescoping radial expansion

device; and

means for injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage at least one of the first and second wellbore casings and cause the inner sleeve to extend out of the outer sleeve into the second wellbore casing to cause the tubular expansion cone to radially expand and plastically deform at least a portion of the second wellbore casing.

10. The method of claim 9, further comprising:
conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.
11. An apparatus for radially expanding and plastically deforming a tubular member, comprising:
a tubular adapter defining a longitudinal passage;
a tubular outer sleeve coupled to the tubular adapter defining a longitudinal passage;
a tubular hydraulic slip body coupled to the tubular outer sleeve defining a plurality of L-shaped bypass ports and a plurality of radial hydraulic slip mounting passages;
a plurality of hydraulic slips movably coupled and positioned within corresponding radial hydraulic slip mounting passages for engaging the tubular member;
a tubular packer cup mandrel coupled to the tubular hydraulic slip body defining a longitudinal passage;
a plurality of packer cups coupled to the tubular packer cup mandrel for sealingly engaging the tubular member;
a tubular shoe positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage;
a tubular inner mandrel positioned within and movably coupled to the tubular hydraulic slip body coupled to the tubular shoe defining a longitudinal passage and a plurality of radial bypass ports;
a tubular expansion cone mandrel coupled to the tubular inner mandrel defining a longitudinal passage having a throat passage for receiving a ball, an L-shaped bypass port, and a radial pressure port;
a tubular expansion cone coupled to the tubular expansion cone mandrel including a tapered outer expansion surface for radially expanding and plastically deforming the tubular member;
a tubular guide nose coupled to the tubular expansion cone mandrel defining a longitudinal passage;
a bypass tube positioned within the tubular inner mandrel coupled to the expansion cone mandrel and the tubular shoe defining a longitudinal passage; and
an annular longitudinal bypass passage defined between the tubular inner mandrel and the

bypass tube.

12. The apparatus of claim 11, wherein the longitudinal passages of the tubular adapter, bypass tube, and tubular expansion cone mandrel are fluidically coupled.
13. The apparatus of claim 11, wherein the longitudinal passage of the tubular expansion cone mandrel is fluidically coupled to the radial pressure port of the tubular expansion cone mandrel.
14. The apparatus of claim 11, wherein the L-shaped bypass port of the tubular expansion cone mandrel is fluidically coupled to the annular longitudinal bypass passage, the radial bypass passages of the tubular inner mandrel, the L-shaped bypass ports of the tubular hydraulic slip body, and the radial bypass ports of the tubular outer sleeve.
15. An apparatus for radially expanding and plastically deforming a tubular member, comprising:
 - a tubular support member defining a longitudinal passage;
 - a tubular outer sleeve coupled to the tubular support member defining a longitudinal passage and a plurality of radial bypass ports;
 - an hydraulic slip coupled to the tubular outer sleeve for controllably engaging the tubular member;
 - one or more packer cups coupled to the tubular outer sleeve for sealingly engaging the tubular member;
 - a tubular inner sleeve positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage, an annular longitudinal bypass passage, and one or more radial bypass passages; and
 - a tubular expansion cone coupled to the tubular inner sleeve defining a longitudinal passage having a throat passage for receiving a ball, an L-shaped bypass port, and a radial pressure port including an tapered outer expansion surface for radially expanding and plastically deforming the tubular member.
16. The apparatus of claim 15, wherein the longitudinal passages of the tubular outer sleeve and the tubular expansion cone are fluidically coupled.
17. The apparatus of claim 15, wherein the longitudinal passage of the tubular expansion cone is fluidically coupled to the radial pressure port of the tubular expansion cone.
18. The apparatus of claim 15, wherein the L-shaped bypass port of the tubular expansion cone is fluidically coupled to the annular longitudinal bypass passage and the radial bypass passages of the tubular inner sleeve, and the L-shaped bypass ports and the radial bypass ports of the tubular outer sleeve.
19. A method of radially expanding and plastically deforming a wellbore casing positioned within a borehole that traverses a subterranean formation, comprising:
 - positioning an outer tubular sleeve and an inner tubular sleeve comprising an expansion cone within the borehole, wherein the inner tubular sleeve is movably coupled to and at

least partially housed within the outer tubular sleeve;
injecting a fluidic material into the inner and outer tubular sleeves;
coupling the outer tubular sleeve to the wellbore casing; and
extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to
radially expand and plastically deform a portion of the wellbore casing using the
expansion cone.

20. The method of claim 19, wherein injecting a fluidic material into the inner and outer tubular sleeves comprises:
injecting the fluidic material into an annular chamber above the expansion cone.
21. The method of claim 19, further comprising:
conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.
22. The method of claim 21, wherein conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:
conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location above the expansion cone.
23. The method of claim 19, further comprising:
depressuring the inner and outer tubular sleeves;
decoupling the outer tubular sleeve and the wellbore casing; and
collapsing the outer tubular sleeve onto the inner tubular sleeve.
24. The method of claim 23, further comprising:
injecting a fluidic material into the inner and outer tubular sleeves;
coupling the outer tubular sleeve to the wellbore casing;
extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to
radially expand and plastically deform another portion of the wellbore casing.
25. The method of claim 24, wherein injecting a fluidic material into the inner and outer tubular sleeves comprises:
injecting the fluidic material into an annular chamber above the expansion cone.
26. The method of claim 24, further comprising:
conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.
27. The method of claim 26, wherein conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:
conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location

above the expansion cone.

28. An apparatus for radially expanding and plastically deforming a wellbore casing positioned within a borehole that traverses a subterranean formation, comprising:
- means for positioning an outer tubular sleeve and an inner tubular sleeve comprising an expansion cone within the borehole, wherein the inner tubular sleeve is movably coupled to and at least partially housed within the outer tubular sleeve;
 - means for injecting a fluidic material into the inner and outer tubular sleeves;
 - means for coupling the outer tubular sleeve to the wellbore casing; and
 - means for extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to radially expand and plastically deform a portion of the wellbore casing using the expansion cone.
29. The apparatus of claim 28, wherein means for injecting a fluidic material into the inner and outer tubular sleeves comprises:
- means for injecting the fluidic material into an annular chamber above the expansion cone.
30. The apparatus of claim 28, further comprising:
- means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.
31. The apparatus of claim 30, wherein means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:
- means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location above the expansion cone.
32. The apparatus of claim 28, further comprising:
- means for depressuring the inner and outer tubular sleeves;
 - means for decoupling the outer tubular sleeve and the wellbore casing; and
 - means for collapsing the outer tubular sleeve onto the inner tubular sleeve.
33. The apparatus of claim 32, further comprising:
- means for injecting a fluidic material into the inner and outer tubular sleeves;
 - means for coupling the outer tubular sleeve to the wellbore casing;
 - means for extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to radially expand and plastically deform another portion of the wellbore casing.
34. The apparatus of claim 33, wherein means for injecting a fluidic material into the inner and outer tubular sleeves comprises:
- means for injecting the fluidic material into an annular chamber above the expansion cone.
35. The apparatus of claim 33, further comprising:

means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.

36. The apparatus of claim 35, wherein means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:

means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location above the expansion cone.

37. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular adapter defining a longitudinal passage;

a tubular outer sleeve coupled to the tubular adapter defining a longitudinal passage;

a tubular hydraulic slip body coupled to the tubular outer sleeve defining a plurality of bypass ports and a plurality of radial hydraulic slip mounting passages;

a plurality of hydraulic slips movably coupled and positioned within corresponding radial hydraulic slip mounting passages for engaging the tubular member;

a tubular packer cup mandrel coupled to the tubular hydraulic slip body defining a longitudinal passage;

a plurality of packer cups coupled to the tubular packer cup mandrel for sealingly engaging the tubular member;

a tubular shoe positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage;

a tubular inner mandrel positioned within and movably coupled to the tubular hydraulic slip body coupled to the tubular shoe defining a longitudinal passage and a plurality of radial bypass ports;

an expansion device mandrel coupled to the tubular inner mandrel defining a longitudinal passage having a throat passage for receiving a ball, a bypass port, and a radial pressure port;

an expansion device coupled to the tubular expansion device mandrel including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member;

a tubular guide nose coupled to the tubular expansion device mandrel defining a longitudinal passage;

a bypass tube positioned within the tubular inner mandrel coupled to the expansion device mandrel and the tubular shoe defining a longitudinal passage; and

an annular longitudinal bypass passage defined between the tubular inner mandrel and the bypass tube.

38. The apparatus of claim 37, wherein the longitudinal passages of the tubular adapter, bypass tube, and tubular expansion cone mandrel are fluidically coupled.
39. The apparatus of claim 37, wherein the longitudinal passage of the tubular expansion device mandrel is fluidically coupled to the radial pressure port of the tubular expansion device mandrel.
40. The apparatus of claim 37, wherein the bypass port of the tubular expansion device mandrel is fluidically coupled to the annular longitudinal bypass passage, the radial bypass passages of the tubular inner mandrel, the bypass ports of the tubular hydraulic slip body, and the radial bypass ports of the tubular outer sleeve.
41. An apparatus for radially expanding and plastically deforming a tubular member, comprising:
a tubular support member defining a longitudinal passage;
a tubular outer sleeve coupled to the tubular support member defining a longitudinal passage and a plurality of radial bypass ports;
an hydraulic slip coupled to the tubular outer sleeve for controllably engaging the tubular member;
one or more packer cups coupled to the tubular outer sleeve for sealingly engaging the tubular member;
a tubular inner sleeve positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage, an annular longitudinal bypass passage, and one or more radial bypass passages; and
a tubular expansion device coupled to the tubular inner sleeve defining a longitudinal passage having a throat passage for receiving a ball, a bypass port, and a radial pressure port including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member.
42. The apparatus of claim 41, wherein the longitudinal passages of the tubular outer sleeve and the tubular expansion device are fluidically coupled.
43. The apparatus of claim 41, wherein the longitudinal passage of the tubular expansion device is fluidically coupled to the radial pressure port of the tubular expansion device.
44. The apparatus of claim 41, wherein the bypass port of the tubular expansion device is fluidically coupled to the annular longitudinal bypass passage and the radial bypass passages of the tubular inner sleeve, and the bypass ports and the radial bypass ports of the tubular outer sleeve.
45. An apparatus for radially expanding and plastically deforming a tubular member, comprising:
a tubular adapter defining a longitudinal passage;

- a tubular outer sleeve coupled to the tubular adapter defining a longitudinal passage;
 - a tubular hydraulic slip body coupled to the tubular outer sleeve defining a plurality of radial hydraulic slip mounting passages;
 - a plurality of hydraulic slips movably coupled and positioned within corresponding radial hydraulic slip mounting passages for engaging the tubular member;
 - a tubular packer cup mandrel coupled to the tubular hydraulic slip body defining a longitudinal passage;
 - a plurality of packer cups coupled to the tubular packer cup mandrel for sealingly engaging the tubular member;
 - a tubular inner mandrel positioned within and movably coupled to the tubular hydraulic slip body coupled to the tubular shoe defining a longitudinal passage and a plurality of bypass ports;
 - an expansion device mandrel coupled to the tubular inner mandrel defining a longitudinal passage, a bypass port, and a radial pressure port; and
 - an expansion device coupled to the tubular expansion device mandrel including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member.
46. An apparatus for radially expanding and plastically deforming a tubular member, comprising:
- a tubular support member defining a longitudinal passage;
 - a tubular outer sleeve coupled to the tubular support member defining a longitudinal passage and a plurality of radial bypass ports;
 - an hydraulic slip coupled to the tubular outer sleeve for controllably engaging the tubular member;
 - one or more packer cups coupled to the tubular outer sleeve for sealingly engaging the tubular member;
 - a tubular inner sleeve positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage, an annular longitudinal bypass passage, and one or more radial bypass passages; and
 - a tubular expansion device coupled to the tubular inner sleeve defining a longitudinal passage having a throat passage for receiving a ball, a bypass port, and a radial pressure port including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☒ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.